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(54) **LIGHT EMITTING LIGHT STRING WITH ENHANCED HEAT DISSIPATING EFFICIENCY**

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H01L 33/64 (2010.01)
H01L 33/48 (2010.01)

(52) **U.S. Cl.**
CPC ***H01L 33/647*** (2013.01); ***H01L 27/153*** (2013.01); ***H01L 33/486*** (2013.01); ***H01L 33/641*** (2013.01)

(58) **Field of Classification Search**
CPC H01L 27/153; H01L 33/00; H01L 33/08; H01L 33/48; H01L 33/486; H01L 33/64; H01L 25/0753
See application file for complete search history.

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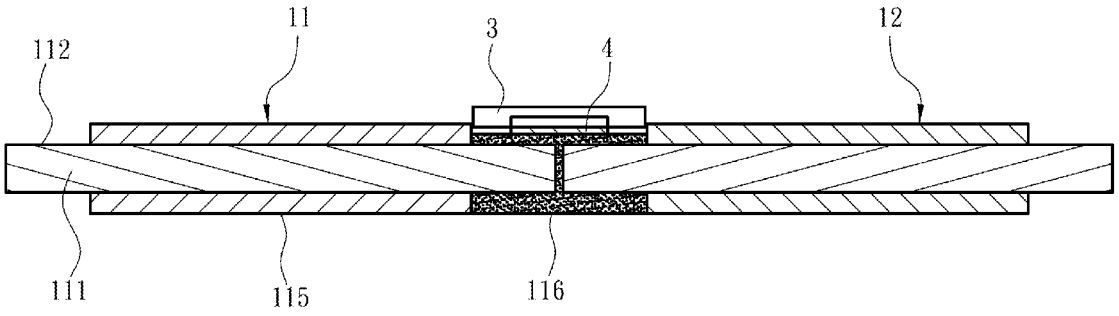
(57) **ABSTRACT**

A light emitting light string with enhanced heat dissipating efficiency includes a first conductive line and a second conductive line disposed in parallel, and at least one surface mounted light emitting diode (LED) disposed across and forming an electrical connection with the first conductive line and the second conductive line. Each of the first conductive line and the second conductive line is formed by a plurality of segments and a conductive heat dissipating material. Each segment includes a conductive core. Each of two ends of the conductive core is an exposed section. The remaining region of the conductive core includes an insulating layer. The conductive heat dissipating material connects the exposed sections of the adjacent segments to form an electrical contact pad region. The surface mounted LED is disposed on one of the electrical contact pad regions formed at the first conductive line and the second conductive line.

12 Claims, 9 Drawing Sheets



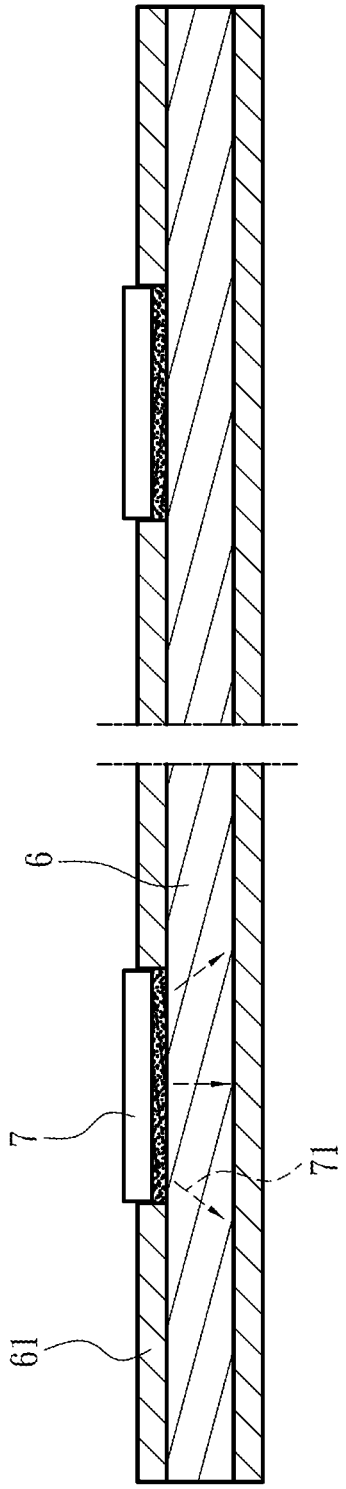
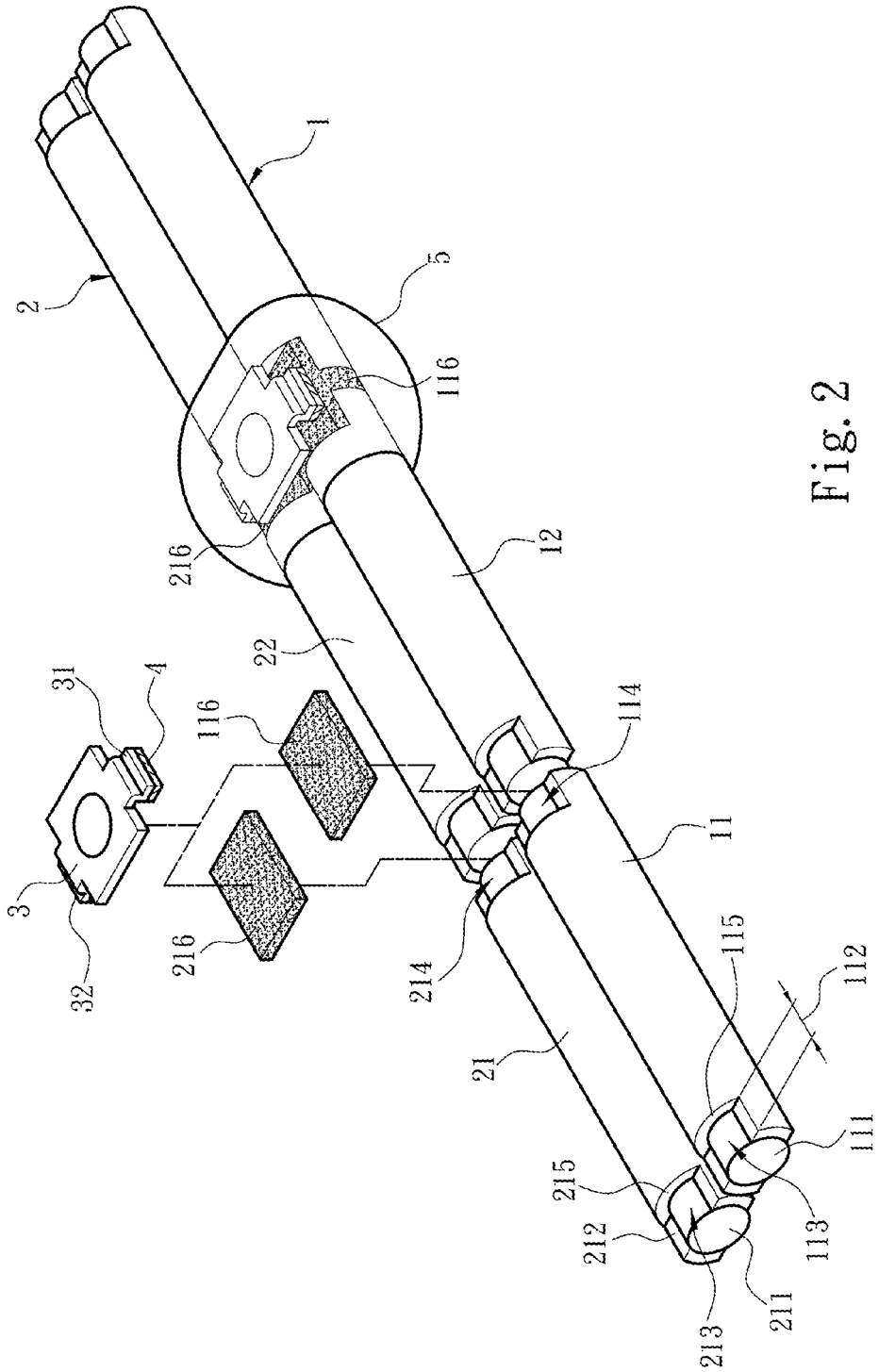


Fig. 1 PRIOR ART


1
2
5
116
216
12
22
31
4
116
114
3
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216
214
11
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112
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111
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212
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213

Fig. 2

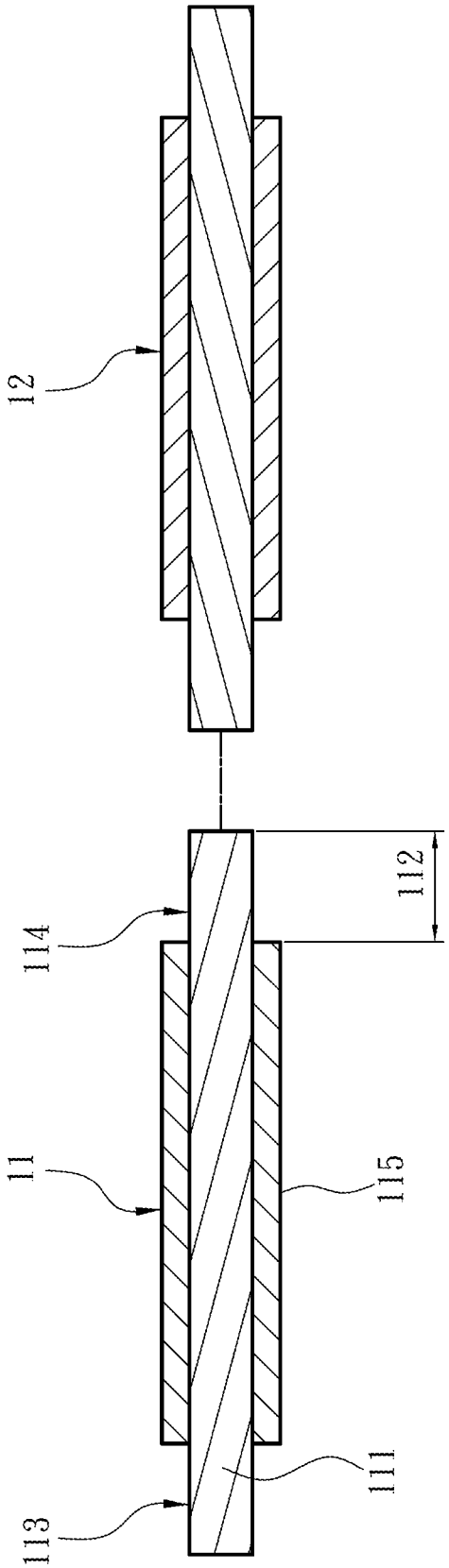

Fig. 3A

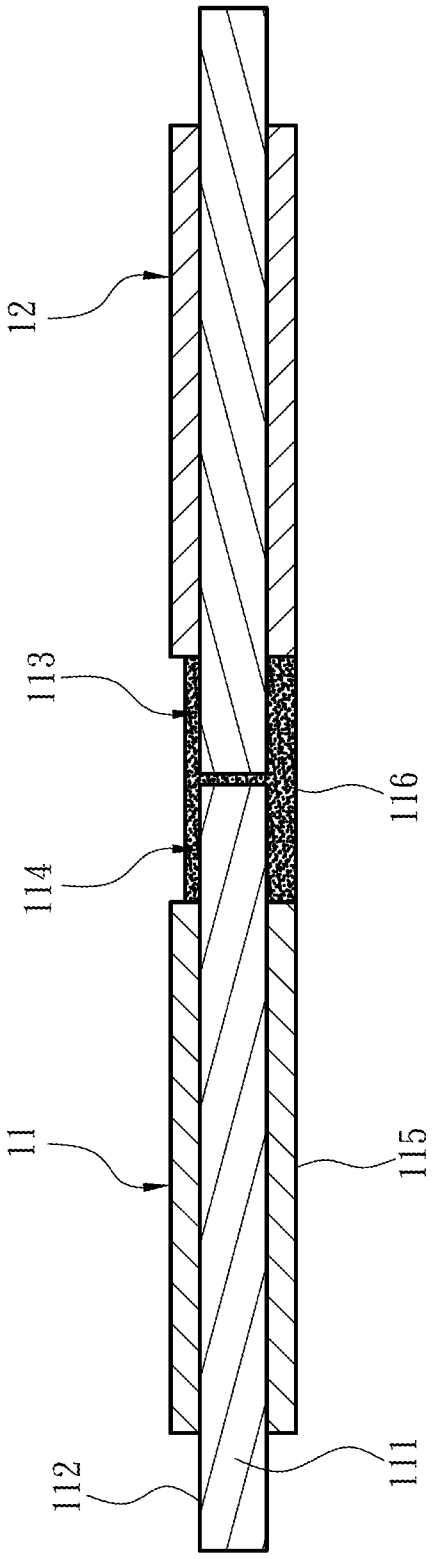

Fig. 3B

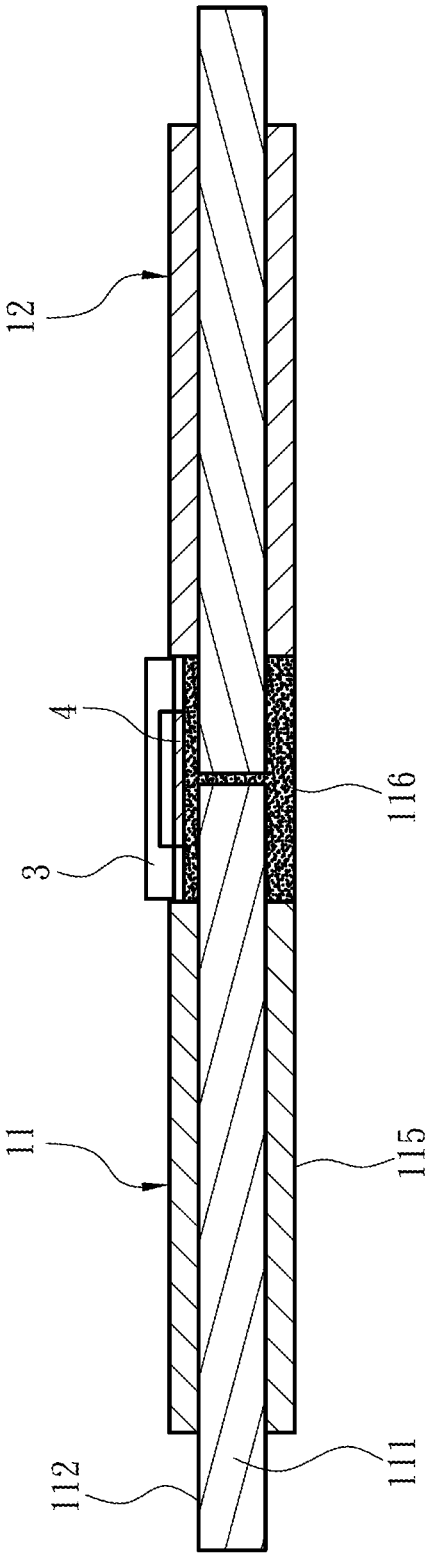

Fig. 3C

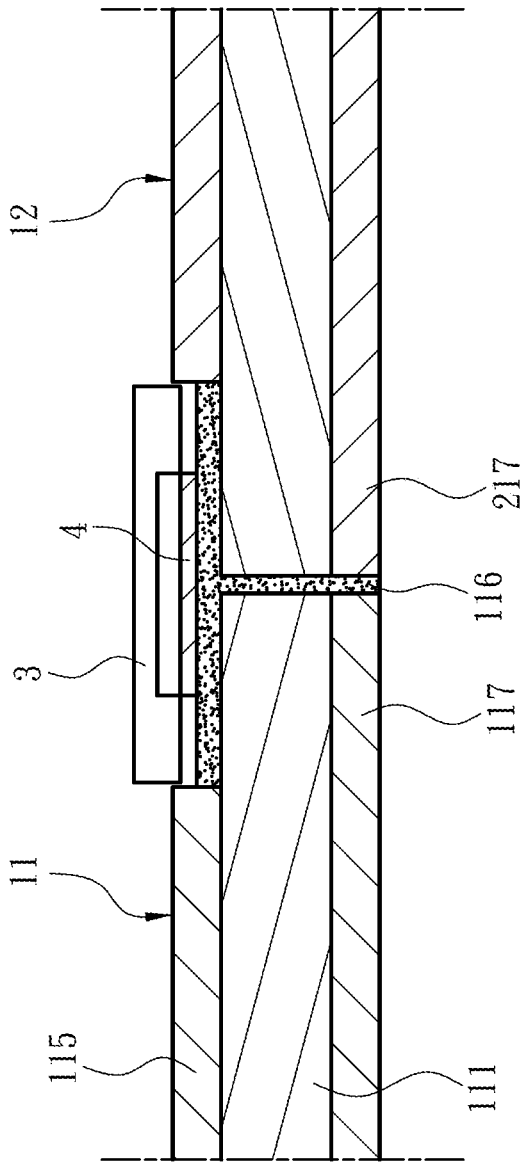

Fig. 4

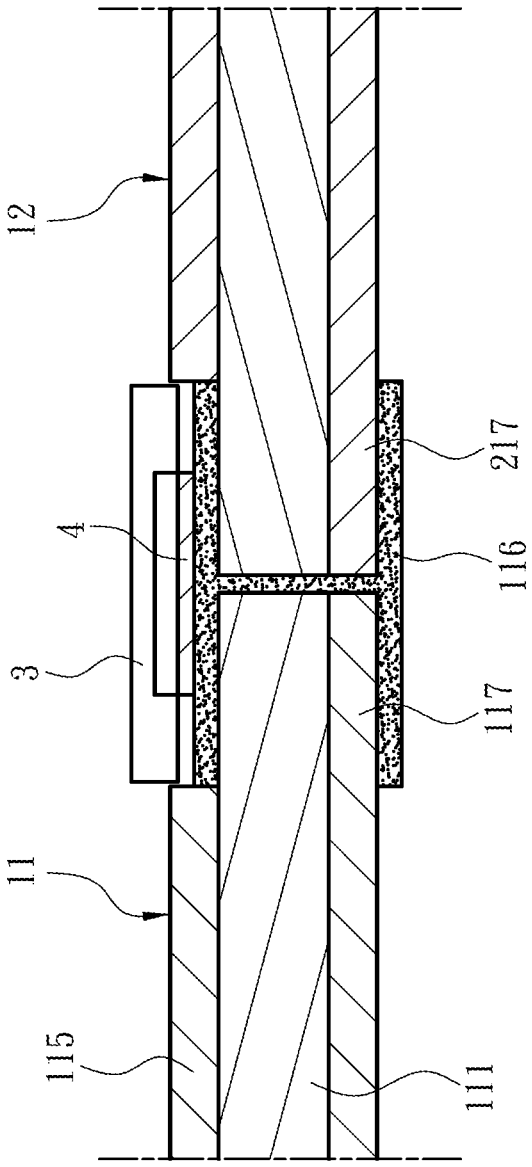

Fig. 5

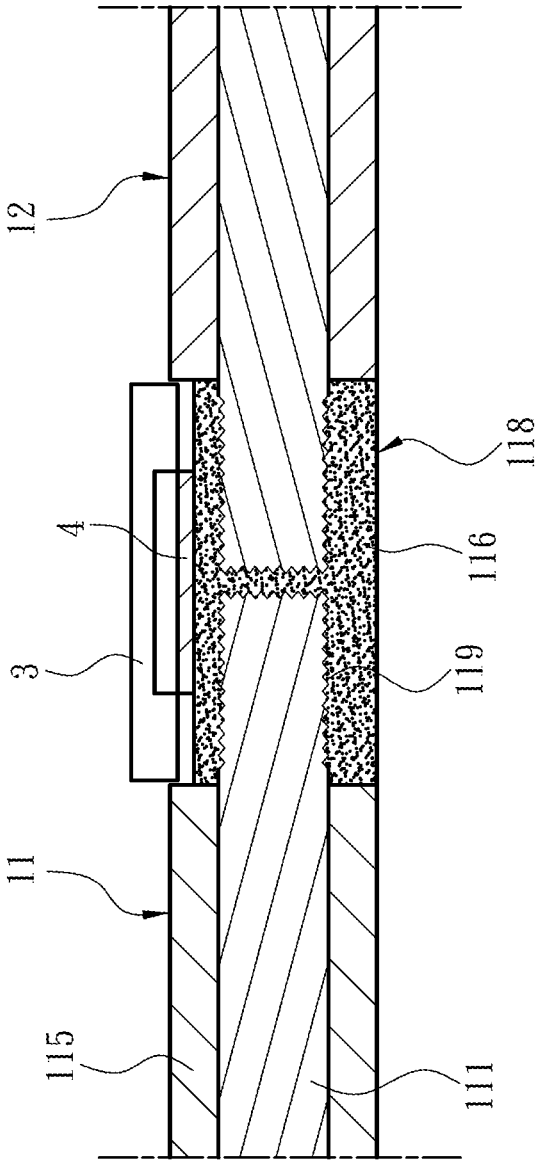

Fig. 6

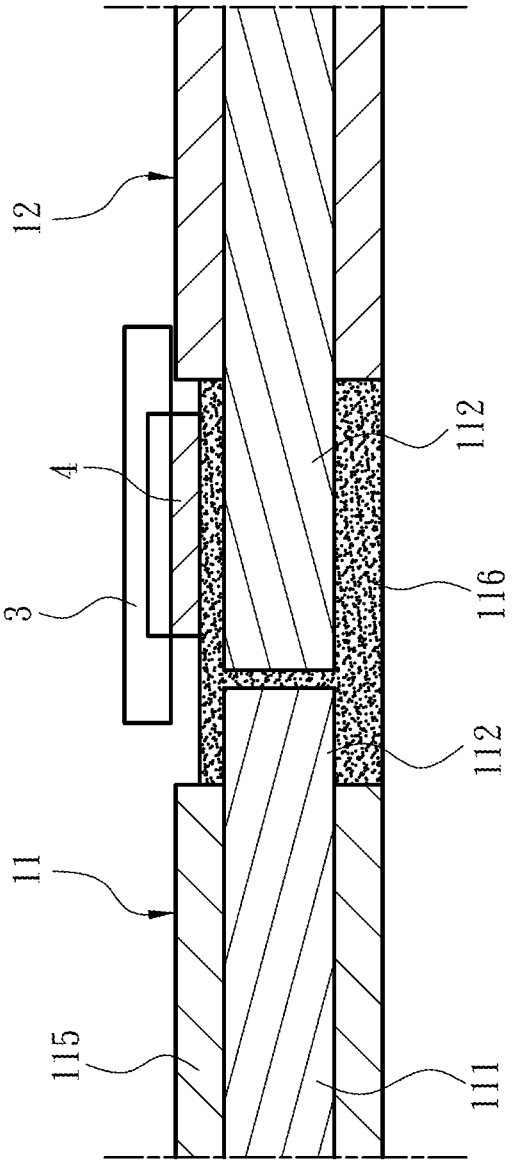

Fig. 7

LIGHT EMITTING LIGHT STRING WITH ENHANCED HEAT DISSIPATING EFFICIENCY

FIELD OF THE INVENTION

The present invention relates to a light emitting light string, and particularly to a light emitting light string that performs light emitting by a plurality of light emitting elements connected in parallel.

BACKGROUND OF THE INVENTION

As people increasingly value holiday celebrations, many manufacturers have started to provide household decorations matching the holiday spirits. Taking a Christmas light for instance, FIG. **1** shows a sectional view of such conventional Christmas light. A common Christmas light is usually formed by two parallel conductive lines **6** and a plurality of light emitting elements connected across these two conductive lines **6**. The flexibility of the two conductive lines **6** enables the Christmas light to be installed at various places according to actual requirements. The conventional Christmas light is likely deployed outdoors. To prevent the two conductive lines **6** from humidity that may cause a failure in conducting electricity, manufacturers of Christmas lights frequently dispose an insulating layer **61** at an outer periphery of each of the two conductive lines **6**, so as to prevent humidity from entering the conductive lines **6**. However, with the popularity of light emitting diodes (LED) **7**, there are also manufacturers that apply the LED **7** on Christmas lights. When the LED **7** is powered on, a waste heat **71** of the LED **7** is accumulated at a rear portion of the LED **7** and further enters the two conductive lines **6**. As the surfaces of the two conductive lines **6** are covered by the insulating layer **61**, the waste heat **71** is confined at the two conductive lines **6**. When the Christmas light is lighted for an extensive period of time, the excessively accumulated waste heat **71** causes the two conductive lines **6** to rise in temperature, and heats and melts the insulating layer **61** to reveal the two conductive lines **6**. As a result, the Christmas light may still malfunction due to the two conductive lines **6** being affected by humidity to even lead to an accident of short circuitry and electrical fire.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to solve of the issue of accumulated waste heat in a conventional solution.

To achieve the above object, the present invention provides a light emitting light string with enhanced heat dissipating efficiency. The light emitting light string includes a first conductive line, a second conductive line, and at least one surface mounted light emitting diode (LED). The first conductive line is formed by a plurality of first segments. Every two adjacent first segments are connected by a conductive heat dissipating material in between. Each of the first segments includes a first conductive core. The first conductive core has each of two ends thereof as a first exposed section, and the first exposed sections are defined into a first exposed pad region and a second exposed pad region. An exterior of the remaining region of the first conductive core is covered by a first insulating layer. The conductive heat dissipating material connects the first exposed pad region and the second exposed pad region of every two adjacent first segments to form a first electrical contact pad region. The second conductive line is formed by a plurality of second segments. Every two adjacent second segments are connected by the conductive heat dissipating material in between. Each of the second segments includes a second conductive core. The second conductive core has each of two ends thereof as a second exposed section, and the second exposed sections are defined into a third exposed pad region and a fourth exposed pad region. An exterior of the remaining region of the second conductive core is covered by a second insulating layer. The conductive heat dissipating material connects the third exposed pad region and the fourth exposed pad region of every two adjacent second segments to form a second electrical contact pad region. Each of the surface mounted LEDs is disposed across the first electrical contact pad region of the first conductive line and the corresponding second electrical contact pad region of the second conductive line. Each surface mounted LED includes a first pin and a second pin, which are electrically connected to the first electrical contact pad region of the first conductive line and the second electrical contact pad region of the second conductive line by a conductive heat dissipating adhesive, respectively. Thus, each surface mounted LED forms an electrical connection with the first conductive line and the second conductive line.

In one embodiment, the first exposed section fully exposes the first conductive core, and the second exposed section fully exposes the second conductive core.

In one embodiment, the first insulating layer includes a first insulating extended portion that extends towards two ends of the first segment and partially shields the first exposed sections, and the second insulating layer includes a second insulating extended portion that extends towards two ends of the second segment and partially shields the second exposed sections.

In one embodiment, the thickness of the first electrical contact pad region on the first segment is equal to the thickness of the first insulating layer, and the thickness of the second electrical contact pad region on the second segment is equal to the thickness of the second insulating layer.

In one embodiment, the conductive heat dissipating material overflows one side of the first conductive line away from the surface mounted LED to form a first heat dissipating portion.

In one embodiment, the conductive heat dissipating material overflows one side of the second conductive line away from the surface mounted LED to form a second heat dissipating portion.

In one embodiment, a plurality of first rugged portions are formed in a recessed manner on each first exposed section to allow the conductive heat dissipating material to be seeped therein. Further, a plurality of second rugged portions are formed in a recessed manner on each second exposed section to allow the conductive heat dissipating material to be seeped therein.

In one embodiment, the lengths of the first exposed sections at the two ends of each first segment are different.

In one embodiment, the lengths of the second exposed sections at the two ends of each second segment are different.

In one embodiment, the light emitting light string further includes at least one sealing adhesive. The sealing adhesive is disposed correspondingly to each surface mounted LED, and encloses the surface mounted LED, each of the first electrical contact pad regions of the first conductive line, and each of the second electrical contact pad regions of the second conductive line.

In one embodiment, the second conductive line is disposed in parallel at a position near the first conductive line.

With the above structure, the present invention provides following features compared to the conventional solution. In the present invention, each of the conductive lines is implemented by segments, and a conductive heat dissipating material is disposed in any of the two conductive lines to form an electrical contact pad region for disposing a surface mounted LED. Thus, the waste heat generated by the surface mount LED that emits light can be dissipated via the electrical contact pad region, thereby solving the issue of waste heat accumulated in a conductive line when a conventional light emitting light string is powered on and emits light.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a conventional light emitting light string;

FIG. **2** is a perspective schematic diagram according to a first embodiment of the present invention;

FIG. **3**A to FIG. **3**C are schematic diagrams showing continuous steps of the implementation according to the first embodiment of the present invention;

FIG. **4** is a sectional view according to a second embodiment of the present invention;

FIG. **5** is a sectional view according to a third embodiment of the present invention;

FIG. **6** is a sectional view according to a fourth embodiment of the present invention; and

FIG. **7** is a sectional view according to a fifth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Details and technical contents of the present invention are given with the accompanying drawings below.

Referring to FIG. **2**, a light emitting light string with enhanced heat dissipating efficiency of the present invention includes a first conductive line **1**, a second conductive line **2**, and at least one surface mounted light emitting diode (LED) **3**. In one embodiment, each of the first conductive line **1** and the second conductive line **2** may be implemented by an enameled insulated wire. The first conductive line **1** is formed by a plurality of first segments **11** and **12**, and every two adjacent first segments **11** and **12** are connected by a conductive heat dissipating material in between. More specifically, each of the first segments **11** includes a first conductive core **111**, which has each of two ends thereof as a first exposed section **112**. In the present invention, the first exposed sections **112** are defined into a first exposed pad region **113** and a second exposed pad region **114**. Further, the first exposed pad region **113** and the second exposed pad region **114** are respectively disposed at the two ends of the first segment **11**. An exterior of the first conductive core **111** located at the remaining region of the first exposed section **112** is covered by a first insulating layer **115**. The first insulating layer **115** may be disposed on a surface of the first conductive core **111** by a processing an insulating material with a procedure such as applying and coating. The conductive heat dissipating material connects the first exposed pad region **113** and the second exposed pad region **114** of the adjacent first segments **11** to form a first electrical contact pad region **116**. On the other hand, in the present invention, the second conductive line **2** may be disposed in parallel at a position near the first conductive line **1**. The second conductive line **2** is formed by a plurality of second segments **21** and **22**. Similarly, every two adjacent second segments **21** are connected by the conductive heat dissipating material in between. Further, each of the second segments **21** includes a second conductive core **211**, which has each of two ends thereof as a second exposed section **212**. The second exposed sections **212** are defined into a third exposed pad region **213** and a fourth exposed pad region **214**. Further, the third exposed pad region **213** and the fourth exposed pad region **214** are respectively disposed at the two ends of the second segment **21**. Further, an exterior of the second conductive core **211** located at the remaining region of the second exposed section **212** is covered by a second insulating layer **215**. The second insulating layer **215** may be formed by the same method used for the first insulating layer **115**, and such details shall be omitted herein. Further, the conductive heat dissipating material also connects the third exposed pad region **213** and the fourth exposed pad region **214** of the adjacent second segments **21** to form a second electrical contact pad region **216**.

In the present invention, the surface mounted LED **3** is disposed across the first electrical contact pad region **116** of the first conductive line **1** and the corresponding second electrical contact pad region **216** of the second conductive line **2**. More specifically, the surface mounted LED **3** includes a first pin **31** and a second pin **32**. The first pin **31** and the second pin **32** are connected to the first electrical contact pad region **116** of the first conductive line **1** and the second electrical contact pad region **216** of the second conductive line **2** by a conductive heat dissipating adhesive **4**, respectively, such that each surface mounted LED **3** forms an electrical connection with the first conductive line **1** and the second conductive line **2**. Further, the conductive heat dissipating adhesive **4** may be a silver adhesive. The light emitting light string of the present invention may further include at least one sealing adhesive **5**. The sealing adhesive **5** is disposed correspondingly to each surface mounted LED **3** to enclose each surface mounted LED **3**, each of the first electrical contact pad regions **116** of the first conductive line **1**, and each of the second electrical contact pad regions **216** of the second conductive line **2**.

Referring to FIG. **3**A to FIG. **3**C, to assemble the light emitting light string of the present invention, the first conductive line **1** and the second conductive line **2** are first provided. Using mechanical processing, the first conductive line **1** is cut into a plurality of first segments **11** and **12**, and the second conductive line **2** is similarly cut into a plurality of second segments **21** and **22**. Lengths of the first segments **11** and **12** may further equal to those of the second segments **21** and **22**. The first insulating layer **115** at the two ends of each first segment **11** is removed to form the first exposed section **112** on the first segment **11**, and the first exposed pad region **113** and the second exposed pad region **114** are also formed. The second insulating layer **215** at the two ends of each second segment **21** is also removed to form the second exposed section **212** on the second segment **21**. The first exposed pad region **113** of the first segment **11** is placed to face the second exposed pad region **114** of another first segment **12**, and the conductive heat dissipating material is applied to form the first electrical contact pad region **116** between the adjacent first segments **11** and **12**. At this point, the first electrical contact pad region **116** formed by the heat dissipating material further forms an electrical connection with the first conductive core **111**, such that a current transmitted in the first conductive line **1** is allowed to flow from the first conductive core **111** through the first electrical contact pad region **116** and then to another first conductive

core **111**. On the other hand, details of how the second segments **21** and **22** form the second electrical contact pad region **216** are identical to those of the first segments **11** and **12**, and shall be omitted herein. Next, in the present invention, the first pin **31** of one of the surface mounted LEDs **3** is fixed on the first electrical contact pad region **116** by the conductive heat dissipating adhesive **4**, and the second pin **32** of the surface mounted LED **3** is also fixed on the second electrical contact pad region **216** by the conductive heat dissipating adhesive **4**. As such, the light emitting light string of the present invention is complete. The manufactured light emitting light string may be applied for Christmas lights. The waste heat that each of the surface mounted LEDs **3** generates when the surface mounted LED **3** is powered and emits light is absorbed by the first electrical contact pad region **116** and the second electrical contact pad region **216**. It should be noted that, in the present invention, the first electrical contact pad region **116** and the second electrical contact pad region **216** are not covered by the first insulating layer **115** and the second insulating layer **215**, and are in direct contact with external air and are capable of directly performing heat exchange with the external air, thereby preventing the waste heat from accumulating in the first conductive line **1** or in the second conductive line **2**.

In the foregoing embodiment of the present invention, an example of the first exposed section **112** fully exposing the first conductive core **111** and the second exposed section **212** fully exposing the second conductive core **211** are given as an example for illustration purposes. Referring to FIG. **4**, in another embodiment of the present invention, each first insulating layer **115** includes a first insulating extended portion **117** that extends towards the two end of the first segment **11** and partially shields the first exposed sections **112**, and each second insulating layer **215** includes a second insulating extended portion **217** that extends towards the two ends of the second segments **21** and partially shields the second exposed sections **212**. Further, referring to FIG. **3** to FIG. **6**, in one embodiment of the present invention, in the process of forming the first electrical contact pad region **116** and the second electrical contact pad region **216** by the conductive heat dissipating material, the thicknesses of a part of the first exposed section **112** and a part of the second exposed section **212** may be designed to be equal to those of the first insulating layer **115** and the second insulating layer **215**. Thus, the thickness of the first electrical contact pad region **116** on the first segment **11** is equal to the thickness of the first insulating layer **115**, and the thickness of the second electrical contact pad region **216** on the second segment **21** is equal to the thickness of the second insulating layer **215**.

Referring to FIG. **6**, in the present invention, in the process of forming each first electrical contact pad region **116** and each second electrical contact pad region **216**, an overflow level of the conductive heat dissipating material is controlled, such that the conductive heat dissipating material overflows one side of each first segment **11** opposite the surface mounted LED **3**, or the conductive heat dissipating material overflows one side of each second segment **21** opposite the surface mounted LED **3**. As such, a first heat dissipating portion **118** is formed at one side of each of the first electrical contact pad regions **116** away from each surface mounted LED **3**, and a second heat dissipating portion (not shown) is formed at one side of each of the second electrical contact pad regions **216** away from each surface mounted LED **3**. In one embodiment of the present invention, through mechanical carving or chemical etching, a plurality of first rugged portions **119** are formed in a recessed manner on each of the first exposed sections **112**, and a plurality of second rugged portions **119** (not shown) are formed in a recessed manner on each of the second exposed sections **212**. The first rugged portions **119** and the second rugged portion allow the conductive heat dissipating material to be seeped therein during the process of forming the first electrical contact pad regions **116** and the second electrical contact pad regions **216** by the conductive heat dissipating material. Thus, the conductive heat dissipating material is allowed to combine with the first conductive cores **111** and the second conductive cores **211** to provide more enhanced heat dissipation effects.

Referring to FIG. **7**, in the present invention, the lengths of the first exposed sections **112** of two adjacent first segments **11** and **12** may be designed to be different. In other words, the lengths of the first exposed sections **112** at the two ends of the first segment **11** are different. That is to say, in one embodiment, the length of the first exposed section **112** of the first segment **11** facing another first segment **12** is different from the length of the first exposed section **112** of the another first segment **12** facing the first segment **11**. Thus, each of the surface mounted LEDs **3** may be disposed at the first exposed section **112** having a longer length to more stably carry the surface mounted LED **3**. Further, although the first conductive line **1** is used as an example for illustrating the present invention, the second conductive line **2** may also be implemented by the same method. Associated details are omitted herein.

What is claimed is:

1. A light emitting light string with enhanced heat dissipating efficiency, comprising:

a first conductive line, formed by a plurality of first segments, every two adjacent first segments being connected by a conductive heat dissipating material in between, each first segment comprising a first conductive core, each of two ends of the first conductive core being a first exposed section and defined into a first exposed pad region or a second exposed pad region, an exterior of a remaining region of the first conductive core covered by a first insulating layer, the conductive heat dissipating material connecting the first exposed pad region and the second exposed pad region of the adjacent first segments to form a first electrical contact pad region;

a second conductive line, formed by a plurality of second segments, every two adjacent second segments being connected by the conductive heat dissipating material in between, each second segment comprising a second conductive core, each of two ends of the second conductive core being a second exposed section and defined into a third exposed pad region or a fourth exposed pad region, an exterior of a remaining region of the second conductive core covered by a second insulating layer, the conductive heat dissipating material connecting the third exposed pad region and the fourth exposed pad region of the adjacent second segments to form a second electrical contact pad region; and

at least one surface mounted light emitting diode (LED), disposed across the first electrical contact pad region of the first conductive line and the corresponding second electrical contact pad region of the second conductive line, each surface mounted LED comprising a first pin and a second pin, the first pin and the second pin electrically connected to the first electrical contact pad region of the first conductive line and the second electrical contact pad region of the second line by a

conductive heat dissipating adhesive, respectively, such that each surface mounted LED forms an electrical connection with the first conductive line and the second conductive line.

2. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein the first exposed section fully exposes the first conductive core, and a second exposing section fully exposes the second conductive core.

3. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein the first insulating layer comprises a first insulating extended portion that extends towards two end of the first segment and partially shields the first exposed sections, and the second insulating layer comprises a second insulating extended portion that extends towards two ends of the second segments and partially shields the second exposed sections.

4. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein a thickness of the first electrical contact pad region on the first segment is equal to a thickness of the first insulating layer, and a thickness of the second electrical contact pad region on the second segment is equal to a thickness of the second insulating layer.

5. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein the conductive heat dissipating material overflows one side of the first conductive line away from the surface mounted LED to form a first heat dissipating portion.

6. The light emitting light string with enhanced heat dissipating efficiency of claim **5**, wherein the conductive heat dissipating material overflows one side of the second conductive line away from the surface mounted LED to form a second heat dissipating portion.

7. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein the conductive heat dissipating material overflows one side of the second conductive line away from the surface mounted LED to form a second heat dissipating portion.

8. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein a plurality of rugged portions are formed in a recessed manner on each first exposed section to allow the conductive heat dissipating material to be seeped therein, and a plurality of rugged portions are formed in a recessed manner on each second exposed section to allow the conductive heat dissipating material to be seeped therein.

9. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein lengths of the first exposed sections at two ends of each of the first segments are different.

10. The light emitting light string with enhanced heat dissipating efficiency of claim **9**, wherein lengths of the second exposed sections at two ends of each of the second segments are different.

11. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, further comprising:

at least one sealing adhesive, disposed correspondingly to each surface mounted LED, enclosing the surface mounted LED, each of the first electrical contact pad regions of the first conductive line, and each of the second electrical contact pad regions of the second conductive line.

12. The light emitting light string with enhanced heat dissipating efficiency of claim **1**, wherein the second conductive line is disposed in parallel at a position near the first conductive line.

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